Menlo Park Notebook #15 [N-78-12-20.3]

This notebook covers the period December 1878-July 1879. Most of the entries are by Francis Upton. There are also entries by Edison and Charles Batchelor. The first page is inscribed "Journal Francis R. Upton Dec. 20, 1878," and page two is inscribed "Dec. 15. These problems given to me when I first came into the laboratory." The first twenty-eight pages contain notes, drawings, and calculations relating to these early problems with electric lighting. Interspersed are notes by Upton on electricity, magnetism, light, heat, the nature of scientific progress, and Edison's work on quadruplex telegraphy; notes on experiments with a spectroscope; and notes on an electrometer. Similar material can be found in Menlo Park Notebook #10. There are also notes, drawings, and calculations on lamps and generators; calculations on thermopiles and batteries; extensive notes by Upton on the gas light industry in Europe and New York, taken from gas light journals for May and July 1879; notes by Batchelor on carbon; and sketches of the telephone. The label on the front cover is marked "Journal," "Gas," and "Upton." The book contains 282 numbered pages.

Blank pages not filmed: 68-81, 86-87, 148-282.

No 15

Pages 1 to 45. "Motor & Sketches on Dynamos, Power Electric Motor, &c." (Unimportant)

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BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

May, 1896

No 15

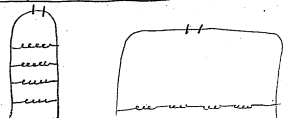
Journal
Francis R. Upton.
Dec. 20, 1878.

4

$\frac{1}{100}$ $\frac{1}{10}$ $\frac{1}{4}$ $\frac{1}{2}$

Dec. 15 These problems given to me when I first came into the ~~[illegible]~~ laboratory.

Example No. 1



100 lamps 10000 ohms, 100 lamps 1 ohm.

How much heat in each lamps.

Heat = C^2R

Ans The same

No. 2 If (+) battery short circuited consumed one oz Zn in given time how much Zn will (+) two cells short circuited consume

Zn = C^2R

~~4 oz~~ 2 oz

Ex. 3 Through 1 Ohm outside

Ex. 4 If a two horse power engine will heat a Cu. rod ¼ inch in diameter of a ~~to~~ to two-thousandths being a length of 30 inches how many lamps per horse power.

~~We take the resistance of the Cu. and of Pt and surface of Pt as compared to Cu. &c and find an estimate of four or six an Ans.~~

Ex. 5 In using one ton of coal the same as 1300 pounds distinguished to make 10000 Cu. ft. of gas

$3 \frac{110000}{2000}$

~~To~~ 2000 gas burners for one hour at 5 cu. ft. per burner = 30.000 candles

1300 lbs of coal will run ~~a~~ 650
Horse Power engine one hour
Jablochkoff claims 600 candles
per horse power

650
600
390.000 candles for 1300
lbs of coal

650
90
58.400

6 lamps of 15 candles ~~burners~~
per horse power
= 90 candles

30.000 Candles for gas
58.400 for Pt. Lamps
390.000 Jablochkoff

Ex. 6 How many pounds of
Pt. will one Horse power
one degree ~~Fah~~
heat in one minute.
772) 33000 (42

One Horse power will heat 42 lbs. of H_2O in in one minute

Sp. Heat of Pt 33 to H_2O = 1

$$\begin{array}{r} 42 \\ 33 \\ \hline 126 \\ 126 \\ \hline 1386 \end{array}$$

lbs. of Pt. heated one degree Fahr. in one minute

Ex. 7. Battery 2 Ohms
Lamp 3 Ohms
Electromotive force 8
$\frac{1}{4}$ inch radiating
How much heat Ans 7.7

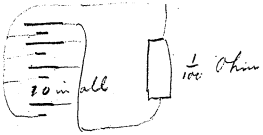
Ex. 8. The same as No. 7 except lamp 6 Ohms Ans. 6.6

Gravitation is not really a force
It is only a condition of
matter. E. The same with
magnetism.

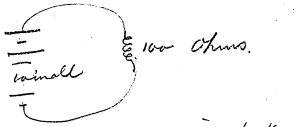
An induction coil may be
short circuited by bringing a
ring of metals round the
field. The first small
Wallace had this defect as on
the ends of the magnets there
was placed a ring of metal.
Edison

Ex. 9 The gearing of wheels
and the weight to be applied
to revolve Magnets machines.

Ex. 10 Heat on wire in this cir-
cuit



as compared to this



various resistances in battery.

"Ether Force"

If it were electricity of high tension there would be very small heating effects for even large sparks.

When the wires are brought to an iron surface for contact, bright scintillations can be seen showing strong dynamic force.

When a magnet is made and remade the whole air and region about it are thrown in a strong diamagnetic stress.

If this stress is removed and wires are left in the field the force will show itself in a spark. If the connection is broken of the wire where does the stress go to? Heat was my first answer, but the following experiment seems to show that there may be

a new form of ~~energy~~ energy.

14 Relays make short to prevent induction. Long magnets give the greatest spark. A short magnet discovers almost instantly while on a long magnet the time can readily be heard.

Useless friction or resistance in the commutator much worse in a machine from intensity than in one for quantity owing to ⅔ of loss.

Machine	100	Ohms
Commutator	1	"
	10%	

Machine	1	
Commutator	1	100%

Ex. 10 ~~The~~ ¾ horse power costs 8/10 of a cent per hour. How much can be expended on a machine to save one horse power the machine to run 10 hours each day.

3.65	
.008	
2.920	
11	days a year
$29.20	
10	interest 10%
$292.00	the interest of

Ex. 11 Why should not a one turn of a coil have as much effect as so many of its ohms equals resistance, for example the whole magnet could be wrapped in copper.

Wire used to prevent vibration. This could be effected with a pad dampened with rubber. The finger is the best known substance for dampening vibrations and rubber comes next to it.

Carbon lamps polarizing the machine must be driven at a higher velocity to overcome this without increasing the resistance.

When the holds of coal ships were ventilated a large n.o. were burned, since the custom has ceased very few burn. This shows that there can be a slow combination of coal, a slow oxydation at low temperatures. A battery is an appliance by which the slow combustion of Zn. is taken advantage

to produce electricity. Zn. and acids cost very much, coal and air are very cheap, if a battery could be made using coal it would be extremely economical. There might be, for example, large pots in which coal could be dumped and wires thrust into it, and wires thrust out away. Carbon and Oxygen have the most powerful affinity for each other of any known substance at high temperatures.

Large thermo piles might be made to utilize the heat of it came from the combustion of coal!

If the world wags on for many thousands years more, there will seem to be no reason why men should not go on discovering and inventing. No reason to doubt that new tricks and arrangements will be made so that Nature may work to our advantage. The scientific journals will go on publishing. Poggendorff the Philosophical Mag. will be fuller than ever now. It is the most unreasonable for men today to be afraid that they cannot find out any more that all has been found.

Men are just beginning to propose questions and find answers, and we may be sure that no matter what question we ask, so long as it is not against the laws of nature a solution can be found.

What is now to be solved is this question. To take the heat from a large coal fire under a boiler and carry it to various points where its intensity and utility it for lighting.

If it were not for the light would not be detected by any known reaction, except the decomposition of a few salts and the indication of the thermo-pile. If the race were blind to the light rays as they are to the chemical rays and

had had gas which could measure hot rays. It would have been many years before the existence of light would have been suspected as it was many years before the chemical rays were suspected. On the doctrine of conservation of energy only a small fraction of the total energy is light. For example, according to Thompson only $\frac{1}{100}$ of the energy of a gas flame is light, and recent experiments have a larger probable error than this.

Ex. 13 Why should not this machine give a constant current?

Wire resistance

Ex. 14.

wire still

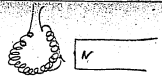
Take steel. a ring of steel and a current passed round in a coil wound completely round to break the ring and find whether it is magnetic.

A Bell telephone will answer taps on the return tank of the diaphragm thus giving an echo on what corresponds to an echo. Thus a simple tap on one diaphragm will be by this echo made into —

Clocks may change their rates ~~too~~ as their position is varied, as the pendulum may pick up earth currents and thus retard it.

—

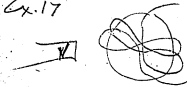
Ex. 15



Would this give constant current

Ex. 16

Ex. 17



Wire wound in the form of a fig 8 and revolved

No current

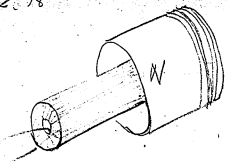
Mr. E. says that he always considers in working for the quadruplex that he was only working from one room to another and thus he was not confused by the amt. of mag. and the thought of the distance.

Phosphorescence may be called the induction of light. The induction of Elec. means that matter is put under a strain which when removed gives a current. Thus a substance exposed to light is put under a strain wh. when removed shows itself in the form of light

In looking through the spectroscope Mr. E. noticed that the light the sky being perfectly clear would vary greatly in brightness. There would sometimes be a lighting up of parts of the spectrum running lengthwise. He watched some hours and at one time noticed the phenomena ~~of~~ with great clearness and saw that a very small cloud could be seen.

Why could not a diffraction grating ~~being~~ made by rotation

Ex. 18



Wire wound on wooden core and unbolted. Would this be a magnet?

Ex. 19

Wire wound on inside coil. Between the two poles.

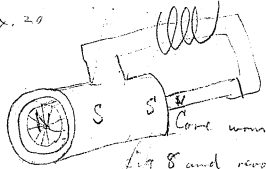
An electrometer may be considered as a galvanometer of great resistance. For example a 20,000 Ohm galvanometer will give indications exactly corresponding to the electromotive force of a battery. If we could have a galvanometer with a resistance equal to that of an inch of air it would give almost perfect indications of electromotive force &

The electromotive force of an element is dependent on the chemical force existing between the substance and the exciting.

The amount of electricity de-

depends on the number of molecules

Ex. 20



Core wound in fig 8 and reversed would it give a constant current?

The question as to the winding

If the current from a Bell telephone is ~~not~~ received round a soft iron core very little effect is produced. The current is lost in twisting the molecules

Vol II Phil. Mag. P. 135

Mention of Arthur Spence.

Jan 12

~~The Cells~~

Electromotive force of Battery

Callaud's cell 1000 Ohms +

$D = 24 + 1^\circ 30' = 25^\circ 30'$

Daniells

$12^\circ 30' + 1^\circ 30' = 14^\circ$

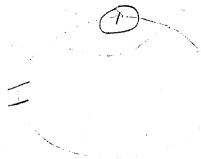
tan 25 30' .476

tan 14° 249

249)476 (1.91 Daniells
249
2270
2241
290

Make a solution of different thick gums and with a paint brush paint round a number of ~~[illegible]~~ ~~[illegible]~~ carbon tattoos on their edge one with each — mark on paper what each are and let us see how they stain

- Arabic aq
- Tragacanth "
- Sectrine "
- Damar alc
- Dammar Pinus aq
- " Pinus alc
- [illegible] alc
- [illegible] alc
- [illegible] alc
- [illegible] alc



Callaud played out

Electromotive force = 1.9 Daniells

measured on 1000 ohms outside resistance

Fresh Callaud

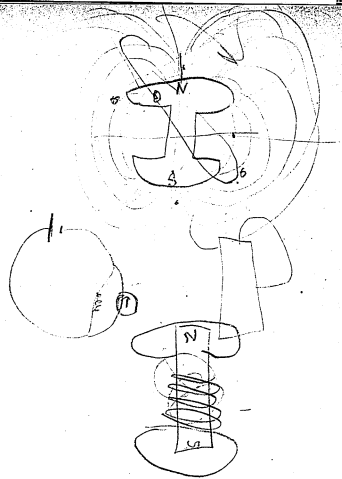
31° 0'

Daniells 1.60

600

32

32) 60 (1.87
32
280
256
240



Resistance Bradley Galvanometer

1 150
2 38 Ohms
3 1.2 Ohm
4 Trafo

Small galva about .5 Ohm

1 spiral	$\frac{1}{4}$ surface	10	ohm
4 "	1/2 "	40	"
7 "	3/4 "	70	"
13	$1\frac{1}{4}$	130	"

13
130

23
10
230

7/4 3 3'

$1\frac{3}{4}$.

1/4
10

1/2 40

4 1/4

1/2 - 10

2 inch

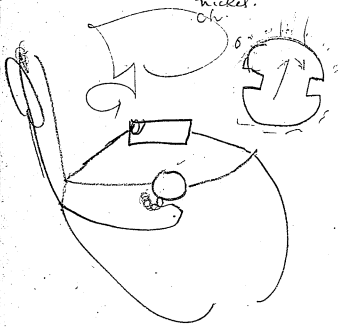
Wt of tail 5-10½
9-5½
9-13½
9-7
34-6

Pt spined Pork 12 Pt 70

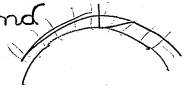
Resistance

Cold	4.6	
Warm	5	
Red	9.3	9.6
White	12.	12.5

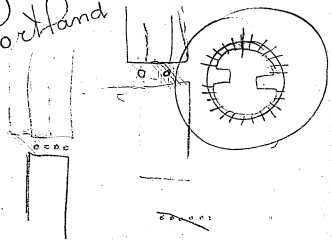
Sulphide Iron
Tin
lead.
zinc
nickel.
Cu



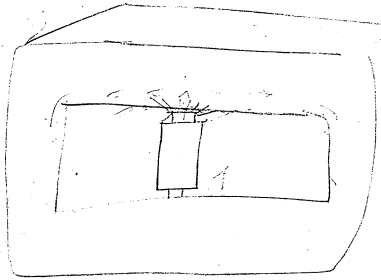
Round



Portland

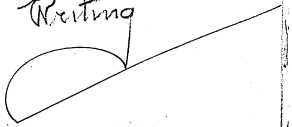


Portland



Round

Writing

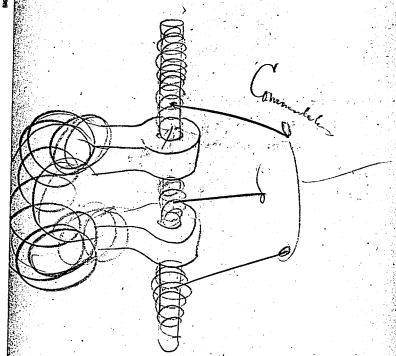


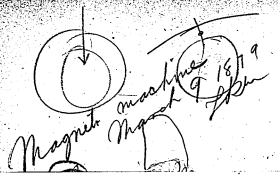
Writing

Round

Writing

12 120
8
960





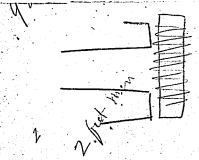
Edison Laboratory Note Book No. 15.

Pages 46 to 53.

Dynamo Sketches.

See Edison Patent:

219,393



12 120
8
960

Edison Laboratory Note Book No. 12.

Pages 46 to 52.

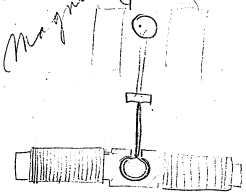
Dynamo Sketches.

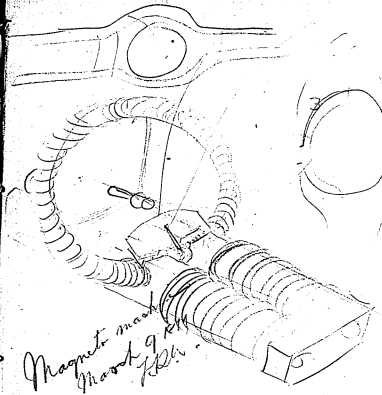
See Edison Patent:

312,704.

4500
2250
1125

Magnet machined March 6 1899 JPL



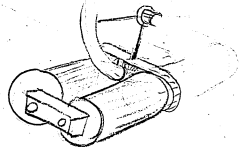


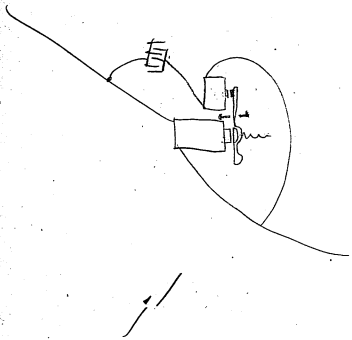
Magnet machined March 9 1899 JPL

20

700
9
6300

Magnetic Machine
March 9 1879
JPK.





Thermo piles

For plating

$\frac{1}{10}$ ohm in cell

Current is the only factor that ~~[illegible]~~ is efficient

$\frac{1}{20}$ Daniell

Cost of Current from battery or Faradic machine as the ~~[illegible]~~ equare of of the current X R

$C^2 R = \text{Cost}$

For example

~~1 Volt~~

Unit of energy the energy given off by one Weber on one Ohm

Faradic

$\mathcal{E} = 20$ Volts

$R = \frac{2}{10}$

$C = 100$

$100000 \times \frac{2}{10} = 2000$ units of $\mathcal{E}$

$\mathcal{E} =$

In Thermo piles, current does not cost directly it is the E.M.F that costs. ~~For example~~ The heat that is required for a thermo must be 20 much in excess of that required that if a fraction only can be used the thermo must be very profitable in low resistance

say $E = 1$ Volts cost 1 on Thermo

R total $= \frac{2}{10}$ Ohms

$C = 5$ Webers

$2.5 \times \frac{2}{10} = 5$ units of E

Cost 5 on Faradic to battery

$E = 2$ Volts

$R = \frac{2}{10}$

$C = 10$ Webers

Cost 20 on Faradic or battery.

cost 2 on Thermo

Gas Lighting

Page 1 scrap book

In a paper read by Mr. C. E. Jones of Chesterfield England before the Association of Gas managers May 1879. ~~It~~ was said: "The chief requirements of public lights are — (a) steadiness of flame — not susceptible to atmospheric commotion; (b), uniformity of intensity; (c) great penetrating power; (e) ever available without preparation and easily lighted; (f) non liability to any sudden ~~at~~ or self extinguish-

ment; (g) shadowless; (h) commercially cheap."

He speaks of the bad designs for street lamps by which useless ornamentation is used cutting off the light.

Regarding glass for lamps
A small proportion of oxide of iron gives a dark color to glass. In selecting remember that next to brilliancy the power to resist atmospheric influences should be considered.
In many places the polish destroyed by atmospheric
Most economical clear brilliant hard glass
The rougher glass is the sooner it becomes dirty.
The loss due to the glass varies with the intensity of the light, and distance from it.
The longer and more powerful the flame the less the loss. Average loss generally stated 9 %

Poor glass smoky intercepts 83.8 % of light
after cleaning 16.9 %
Ruby glass intercepts about 50 %
Blue glass " " 38
Ground " " " 22.3 %
Yellow " " " 11.6

Pipes eaten away and jar affects the pipe making often bad leaks
In London lamps cleaned twice each week, in many places once a week
Normal rate of consumption five feet an hour

408 England Stourbridge

25
40
$10.00 for 2400 hours street lamps

log $2.25 to $2.50 per lamp

2400) 12.500.0 (.52
12000
5000

5.2 miles per hour per street lamp

Newcastle

5 feet of gas an hour
lighted burners 13.68
power 10.54

Street lamps 60 to 100 yards

Roughly lamps use
7.41 to 4.91 feet an hour

Main lights 80 lamps
50 minutes

Corners of streets strong gas light

Lamp posts 10 to 11 feet high

Main light 105 lamps
speed four miles an hour

Ton of coal in retort
14 cwt ~~for~~ coke

25 % coke used for heating retorts
~~13.66~~ 10 cwt for sale

13 x 6d for coal = $3.37
Coke & fittings 100 6½ = 2.60
$ .77 for gas

Waterloo bridge previous to E. L.

2½ cu. feet 7 candles

5½ d. per hour 43 lamps

11 cts 43

43) 11.0 (2.5 2.5 mills
86
240
215
5

¼ ct. per hour

Sugg. large burner
4 candles per cu. ft

$250 per ton for Coke in England

Pages 67 to 82." B L A N K".

2

132.
9
924.

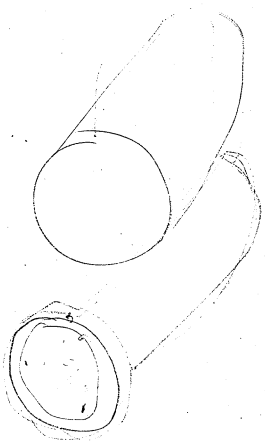
7.

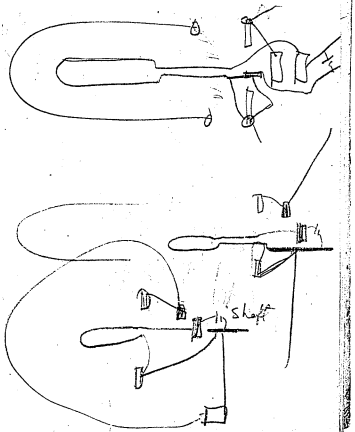
100.

66
6
396 0

March 5. 1879

Experiments with the small dynamo electric machine, wound with odd number coils and arranged with field magnet. in and out also with cutting cylinder rotating and non rotating – Hand turning –




Shaft

75
9
54 cts
2

43,571 and 68
20,800 and
5[illegible],771 000
7,484 | 4954000.0
4490 4000
46360

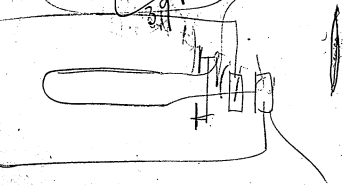
543357
7484 | 8,712 | 116
7484
12280
7480
4960

195 000 and 11
39 000 000
Founder

Laboratory

168 000 000
16,800 000
111,7
5 | 12,945

195 745
391



1.6

50
500
2500
444
10000
10000
1.6) 110000 (1

16 / 145 — 16 / 10 — 160 / 80 — 3

110000 / 1 — 10 / 16 — 1.6) 110000 (68750

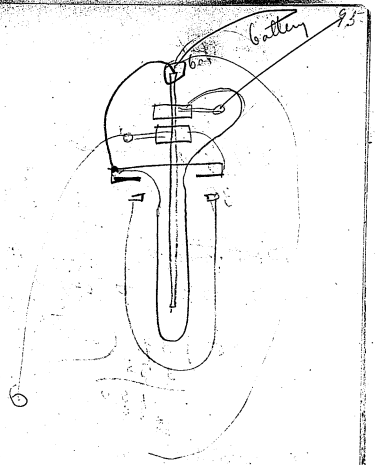
4

1 80
1 20
10
1 60
80

4

3.2) 68.7500 (2.
2.750

68750



1000 feet

$ 5.00
50 cts

5 | ~~195,000,000~~
39.000,000

~~118 000,000~~

7.484,000,000

7.5) 39.15.20
3 75
150

Paris $ 5.20 investment
1.000

5 20

25

365
25
1825
730
8.125

~~1,000,000~~
~~10,000~~ stations
in Paris

8
5
$ 40

20510
~~1,000,000~~ stations
in Paris

8) 7.484,000
935,500

365) 7484000 (20510
730 0
1880
1825
550
365

20570

$300,000
$30 a lamp

8) 3000 (~~$~~3
24
.37 cts interest
.26

8) 3.0
.37
.26
.63 cts

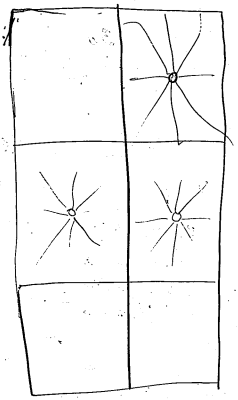
to sell at and pay
100% on investment

30.
200200
$30 30

4 lbs of coal
10 lights 1000
$35 1000

~~$40000~~ $60

4 lbs 10 lights
4000 lbs an hour
20000
$35 — five hours run
$20 wages and oil
$10 extra
$65



10000
25
250000

250) 65.00 (.26 cts
500
1500

40 000000
$ 8 000 000 Expenses
7.884,000

74.800,000
34,000.000
20,800 000
4.0

54.000.000
10.800 000

74) 108 (1.40
74
340

£ = $500

55
15
825
86500
5
432500

63725
5
489) 318,625 (6.5
2934
2622

54,654) 432,500 (8

max quantity left works in 24 hours 296 ~~000~~ lbs

~~432~~
365) 54,654 (149
365
1815
1460
3554

250000

Max

Hereford
Journal of Gas lighting
May 27, 1879.

$ ~~433000~~ borrowed 318625
54000 transmitted M cu. feet
48700 ~~transmitted~~
$ ~~1500~~ capital ~~has~~ ~~transmitted~~ ~~in~~ M a year
$6.50
cu. feet

~~Max. quantity~~ produced 275 M
Max quantity left works in one day 296 Thd
Average " " " " 149 Thd
Lost 10.42 %

10 Thd ~~was~~ sold for ~~ton~~ of coal...

398
81
479) 810 (17
479
3310

9 401
5
5000) 47,005

54654
.704
218516
$1.00 54654
5683.9.16

5372
5
26860

54600
5680
489 20

490) 537 (1
480) 2680 (54
2400
2800

922
5
4610

4012
1173
2839
5
4695

49,000) 4,610 (9
49,000) 146,90 (29
98
489
F

39.863 Lbd Private
8.183 " Public lamps

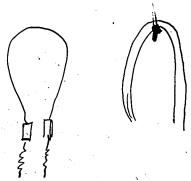
83% private lamps
17% public

Sold $100 per M

~~Total~~ Cost 54 cts per M including exclusive interest & calls at the mill Counter
actual cost 45 cts per M

Interest 29
Total cost 74 cts

Interest 44 1/2 per cent on loans



·81

3.1) 1.062

London
Profits rising from
3% in 1851 to
10% in 1862

Albert Hall average
use 43,000 25000 cu. ft. a night;
30 sun burners
each 105 fish tails
consumption at rate of
2½ per fish tail for sun
burners 7875 per hour
With such burners 1 cu. ft.
will give 1½ candles
7½ candles five feet
Total candles 11.862
also to wall burners

0.5160
3
1.5480

27 3.2
3.2

35 cu ft one meter

8.721.500
5
43,032,500

690,000
5
3450000

London 864.014
5
4320.070

1,162,000
5
5810000

500 000
~~12000~~
5
~~6160~~

290,000
6
1740000

~~250~~

London £ = $5.00

6 Companies
Capital Employed

Chartered	$43,032,500
Commercial	3,450,000
London	4,320,070
Phoenix	$5,810,000
South Metropolitan	2,500,000
Surrey Commercial	1,450,000
Total	~~$36,662,570~~
	$61,162,570

Capital ~~water~~ per 1000 feet sold

Chartered	~~$4.10~~ $4.10
Commercial	~~$2.75~~ $2.75
London	~~$4.43~~ $3.43
Phoenix	~~4.52~~ $3.52
South Metropolitan	$2.52
Surrey Commercial	$2.87

Best $2.52 in ℓ

8

$20.16 per lamp 8.44 per year

$20.16

Estimate $250,000

10,000

$25 capital per lamp

1/8

2 Ohm 60 lights 1/8 H.P.

~~Hp ohm~~ 2 Ohms

11 55 lights

$3 a light dynamo

$7 conductor

$8 ~~H.P.~~ Engine

$1 Boiler

2

$21 per lamp capital

~~London~~

~~Gas per foot~~

8.28

$2.62 per

~~200 lbs of coal 1000 feet~~

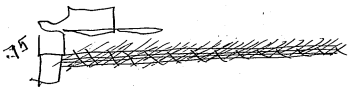
~~2c~~ 2½ cts an hour

~~25~~ .128 per hour per lamp

200

~~$6.00~~ cts. coal Elec.

62 cts coal gas



Models

31 000) 5000000 (161
31
190
156
40

715) 5,000,
4296
7100

(6.9

$161

73,000) 715,676 (98
657
586
584
27

Coal/15) 445,000 (62
4286
1700

715) 665,000 (94
6335
3150
6.96
8

$53.28 invested per burner

365
25
1825
630
8.025

on hypothesis that five hours each day five feet an hour 8.025 ft. a year

Manchester Mr Hunter
Hyde committee Salford Gas works

186 miles mains $161 capital a commer
30,000 consumers
5,871 street public lamps

Product 715,676 M year

Capital $5,000,000 = £1,000,000
$6.90 per M

73,000 tons of coal used
9.800 cu. ft. per ton

Ttl Expenses £89,000 = $445,000
62 cts per M

Income 133,000 665,000
94 cts per M

as in another place
87 cts is said to be the price of gas the ~~cost~~ 94 cts must mean inclusive of coke

gas 20 candles per M

~~Lowo~~) 715,696
23.3

say 5 feet an hour

5) 23,333
365) 4666 (hours
365
1010
730
2800

715) 5000 (7

23.3
.87
1631
1864
20.271

Salford

23 1/3 M for consumer a year
5 ft an hour
12.8 hours a day

$20.27 a year average gas bill

344)1440(41
1376
640

365)4000 (12
365
750
365
344) 144 (

4.1 mills

.84 cts a M
5 feet an hour

Paris
10 candles
344 street hours 74.22
$1.44 an hour
4.1 mills per hour
10 candles on ground
4000 hours per annum
from sun rise to sunset
12 hours a day
five feet an hour
10 candles on ground
Z

1275) 45097 (35.6 cu ft = 1 cwt
38251
6757
5875
882 0

31.317 cuft in one metre

250) 650 (2.6%
500
1500

250) 1200 (48%
1000
2000

24) 1657.50 (69
144
217
192
255

Paris

365) 7484 (2.05
730
1840

~~39 1000~~

7.484) 39 10000 (52
37420
16800

250) 690 (2.7%
500
1200

163 800
8
819,000

218.938

244) 218.0 (.89
195 0
2280

218) 819 (3.75
654
1650
1526
1240

15.645) 819,000 (52
782 25
36770

15,645) 1,072,065 (6
938 70
133360

218) 1,072 (4.9
872
2000

15,645) 219,577 (14
15645
6312
62580
5470

Rockdale

Capital account

£ 214.473 = $1,072,065

Value works $819.000

Gas made 244.738 M

Gas sold 218.938 M

11% lost by leakage

$3.75 value of property to M per year

$4.90 capital to M per year

15.645 consumers

About 14 M per consumer per year

40.283
5

15.267) 201415 (14
15267
48745

44000
5
220000

219.577) 220,000

Co 20,215
5605
14610
5
83050

9685
8018
25605
23.364

50.475
23.308
27167
5
1135.835

219) 135.83 (62
1314
473

218.7~~18~~) 1072~~4~~ (.~~4~~9
~~1969~~
876
1960
1962

Rochdale

$14 a year a consumer

$1.00 a M

Cost of gas 62 cts. per M

Dinder

292,000 M

4s 2d = $1.04 per M

~~29~~ 26 candles

6.82) 18900000
1364
4260
4092
1680

262000
5
1310000

Bradford

The average of profits for eight year was 5.09 %

£ 262,000 capital

$ 1,310,000

New York

466
1600
~~170~~
4000
2500
5000
18000
4000
270
19536
2720
22,256

170
1000
900
750
2720

2.000
1200
1000
1000
1000
1000
500
7700

320
625
700
1645

In New York city according to the par value of the stock July 16, 1879

$19.536,000 stock
2.720 000 Bonds
22 256.000 Bonds & Stock

Brooklyn

$ 7.700,000 Stock
$ 1.645.000 Bonds
$ 9,345,000 Bonds & Stock

3.81) 13.56 (.56
1143
2130
1905
2250

1.059.235
V1.256
1110491

11.10) 13565 (12.22
1110
2465
2220
2450
2220
2300

365) 3.814.671 (10,451
365
1646
1460
1867
1825
42

Germany

No Private works 262
Capital £2,713,117 = $13,565,585
Annual production 3,814,671 M
Capital per M $3.56
No. public lights
51,256
No. private lights
1,059,235 light.
$ 12.20 per ~~consumer~~
capital
Average per day 10,451 M
Maximum in a day 16.559 M

138

7956) 28.741 (3.61
2385
4891
4776
1150

1.744
82
1830) 17440 (95
1647
970
915

Germany

Municipal works No. 220

Capital £ 5,748,425

$ 28,741,125

£ as produced

7.956,000 M

Capital per M $ 361

Public lights 86,481 — 5%

Private lights 1.744,713 — 95%

28.741.125
13.565.585
$ 42,296,710.

365) 7 956 000 (2179
730
656
365
2910
2555
3550

100 : 108 :: 60 : X
60
6480

100 : 108 :: 60 : Y
60
6480

Germany

1,744000
86 481
1,830,481) 7,956,000 (4.4
7220
7360

4.400 cuft. per lamp

1,059.235
5 1.256
1,110,491

1,110,491) 3,814,1 (35
3330
5840

~~$1,780 a year for street lamps~~

$10 three light meter
12

$17 3.50 Meter
per light

12 inch main costs

$3.50

$

3 39.000,000
60
22
20
45
400
686 00

2.50 000 000

If the Edison can make light, less than 62 cts

500 000 000 a thousand in England

$4.00 a ton for coal

1000 H.P.
400
2 Tons an hour

10000
5
50000

$8 for coal

Madrid

7.346.910 lin meters
35

36 734 550
22 040 730
25,7 14,1 850

257,741 M

Profits £ 80.923
5

257.741 | 404615 | 1.5
257741
1468740

Profits $150 per M

Portland

Portland

Portland

Portland

Portland

Portland

Portland

Portland

Keely

Keely

Keely

Keely

Pt.

365
25
1825
730
9125

365
12.5
1825
730
365
4562.5

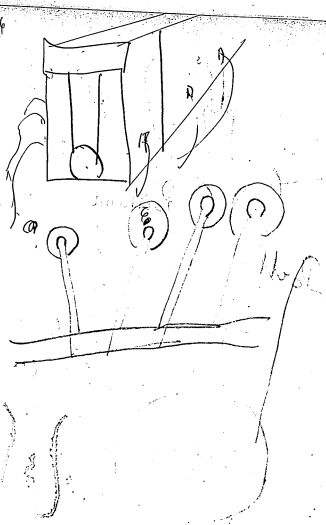
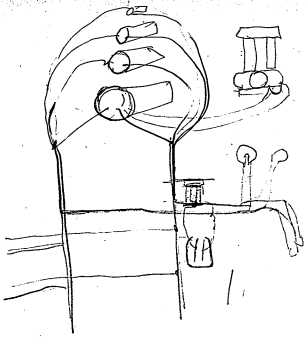
Portland

Portland

Portland

Portland

Portland

Portland

Portland